SWOT Analysis of Near Field Communication Technology

James Jandebeur
Colorado State University – Pueblo

Juyun Cho
Colorado State University – Pueblo

Sung Eun Lee
Colorado State University – Pueblo

Arne Schaeufele
Colorado State University – Pueblo

ABSTRACT

This paper presents strengths, weaknesses, opportunities, and threats of the Near Field Communication (NFC) technology, which has emerged recently and has potential to be adopted in various industry sectors. NFC-equipped devices can provide many features, perhaps among them most notably the ability to perform proximity mobile payments, allowing the consumer to make a variety of financial transactions at special locations provided by banks, retailers, and other service providers. For the customers, we examined if the benefits of convenience and security are worth the price of an NFC-enabled device. For the service provider, we explored if it is worth the cost to set up the infrastructure for those devices to be used. Authors believe that the NFC-equipped devices eventually replace the commonly used plastic card for both convenience and security. The most ambitious plans would remove the need for anything but an NFC-enabled device for all identification and financial transactions, though this is likely to be further in the future than adoption by selected companies.

Keywords: Near Field Communication, Radio Frequency Identification, mobile payment, tags, contactless payment

INTRODUCTION

More and more people are using smartphones today, and almost every new phone has innovations to make life easier and more comfortable. One of recent innovations to the smartphone is Near Field Communication (NFC), which provides the ability to transmit information over a short distance. Both cell phone manufacturers and service companies are convinced this technology has great potential (Strommer, Hillukkala, & Ylisaukko-oja, 2007). The number of smartphones with implemented NFC has increased rapidly and is expected to continue to grow more in coming years (Baker, 2011). Alone or in combination with other smartphone features, NFC has the potential to bring numerous benefits to its users, including: cashless payments, the ability to use the smartphone in place of traditional credit or debit cards (Bodhani, 2011); user identification, allowing the phone's owner to provide proof of identity with built-in biometric recognition or password protection (Derawi, McCallum, Witte, & Bours, 2012); and data retrieval, allowing information exchange between two smartphones or a smartphone and a stationary node designed for that purpose (Strommer, Hillukkala, & Ylisaukko-oja, 2007). These features have the potential of increasing marketplace efficiency, reducing costs to both purchasers and retailers if the infrastructure is put into place.

LITERATURE REVIEW

NFC is a wireless communication technology that enables machine-to-machine data transfer over a short range using the concept of Radio Frequency Identification (RFID). NFC-equipped devices can be utilized in three different modes. First, NFC-equipped smartphones can be used in a read/write mode, with the phone as the active component, the one that generates the field, to interact with a passive tag. The range to which this field is generated is short, reliable to about ten centimeters (Nambi et al., 2012). This is the source of the name, Near Field Communication. The passive tags can act as an address, directing the smartphone to a repository of information. So, for example, a tag might be placed on or near a product for sale, a bookshelf in a library, or a map in a park. When an NFC-enabled smartphone is moved near the tag, the phone downloads the appropriate materials, such as the specifications for the item, a list of books on the shelf, or information about nearby sights in the park (Nambi et al., 2012). Second, A NFC-equipped device can be used as Peer-to-Peer mode (Strommer, Hillukkala, & Ylisaukko-oja, 2007; Nambi et al., 2012; Serfass, 2012) by allowing two users to exchange information between their devices,

such as music playlists, contacts, and even medical data (Morak, 2009). Similarly, information could be exchanged between a NFC-equipped smartphone and a kiosk installed for that purpose. This provides greater speed, reliability, and security than the regular cell phone transmission system because the smartphone is connecting to a wired node, and the signal is transmitted to such a short range rather than broadcasting. A final mode for an NFC-enabled device is card emulation mode, in which the NFC device behaves in the same way as a tag rather than the field generator (Nambi et al., 2012). This mode is used to allow for contactless payments, in which the payment medium (in this case, the phone) is simply waved near a receiving device to initiate the transaction. This type of contactless payment is not new. The wireless provider Sonera offered this type of service for buying soft drinks from vending machines in 1997 (Chandra, Srivastava, & Theng, 2010). What is new is the inclusion of this convenience in the smartphone itself.

NFC technology was developed as a joint venture by Nokia, Phillips, and Sony to provide fast and easy two-way wireless communication on mobile devices such as Personal Digital Assistants (PDAs) and cell phones. The three companies sought to create a standard for this new technology and develop uses for it, such as in retail markets. The NFC Forum was established expressly for these purposes, as well as to promote the technology (Strommer, Hillukkala, & Ylisaukko-oja, 2007). NFC-equipped smartphones debuted in 2010, and it is expected that NFC will be adopted by 28% of the market by 2015, based on the current rate of adoption in new and near-future models of mobile devices. This rapid increase is due, in part, to improvements in infrastructure, a pre-requisite for gaining the most benefit from NFC devices (Baker, 2011). While there are still restrictions on infrastructure and standardization (Pope et al. 2011), the explosive spread of smartphone use and wireless Internet infrastructure is likely to make the use of NFC-capable devices more common in the future.

One of the most prominent functions of NFC is allowing efficient payments. This can be accomplished using either the card emulator or the read/write mode. Both methods are examples of proximity mobile payment, also called contactless payment or proximity m-payment. An m-payment is simply a payment made using a mobile device rather than a traditional payment (cash, checks, or cards) or an e-payment (a payment over the Internet). Of the two methods of allowing the NFC-enabled device for payments, the card emulator is the easiest to adopt. A

number of stores already have readers for smart cards, and that is all it takes for the use of the smartphone as a payment medium. This reduces the number of cards the user needs to carry, but is otherwise exactly the same as using a debit/credit card at the point of sale (POS) (Nambi et al., 2012). While the card emulator mode is easy to implement, it does not offer much that is new aside from saving the user from having to carry cards. The read/write mode is a much more interesting choice. An example of using NFC-enabled phones in read/write mode is the "mobile wallet". In this case, the smartphone is moved near a tag which contains the payment information. This causes the phone to contact the mobile wallet provider and transfer funds to the seller, completing the transaction almost instantly when verified by the buyer (Nambi et al., 2012).

One sign of the growth of NFC is the early adoption of the technology by individual organizations. While this is not widespread, it indicates a level of confidence that NFC will continue to grow. The level of adoption varies by region: in Eastern countries, it tends to be on a national level, while adoption in Western countries is usually more localized. Japan, for example, already has much of the infrastructure in place for NFC. The telecommunications company NTT DoCoMo already uses the technology, and other companies, such as KDDI, are following by preparing to launch NFC standardized phones. NFC services for transportation and vending machines are already common in Japan using FeliCa, an older NFC-like system from Sony. The telecommunications companies are now attempting to support both NFC and FeliCa (Clark S., 2012; Data Monitor, 2012). NFC is also being used in advertising, such as Pepsi providing advertising information on tags in the subway system that provides detailed information about their products (Clark S., 2012). Meanwhile, the National Museum of Korea is putting the technology to use as an electronic tour guide. The museum has placed tags so that visitors can retrieve detailed information about exhibits on their smartphones. This reduces the need for human guides and provides other benefits, such as the information being available in several languages. This can attract more visitors to the museum, since guests do not have to wait for a tour and can move freely through the museum. The smartphone can also link the tour to social media, such as Twitter or Facebook, allowing the experience to be shared online. This creates museum promotions at no additional cost (Clark M. , Korean museum offers NFC visitors guide, 2012).

Also in use in Korea are displays in subways using NFC for purchasing. Pictures of various products are put up on the walls in waiting areas with embedded tags. A purchaser moves a smartphone near the tag in read/write mode, the transaction is initiated, and the purchasing information is transmitted to the physical store. Once the payment is confirmed, the seller prepares and delivers the product to an address specified by the buyer. This allows people to shop while waiting for the train.

While NFC adoption in Japan and Korea appears to be going smoothly, consumers' willingness to adopt is less clear elsewhere. Still, there have been inroads. For instance, two theaters in Australia have just started to use NFC services. MasterCard has developed an application called QkR, allowing the consumer to pay for refreshments using the smartphone. The order is then prepared and picked up with a shorter wait. In addition, Australia's major mobile network operator, Vodafone, is planning to launch a service called SmartPass NFC Mobile Wallet. Smartphones are not the only electronics suitable for NFC. Nintendo has enabled NFC services in their new product, Wii U. The console will allow financial transactions in a similar manner to Mobile Wallets. Therefore, there is no need of another NFC payment device when purchasing a variety of online products. Instead, some purchases can be made within the games. This extension of NFC into the gaming market is likely to bring a number of improvements, as gaming is one of the drivers of computer technology (Data Monitor, 2012). At the international level, Google has developed Google Wallet (Douglas, 2012), another example of a mobile wallet service. While not in widespread use so far, the fact that an organization as large as Google is interested in this technology means it is likely that others will follow. The New Jersey rail system hopes to take advantage of this service, though movement in that direction has been slow (Data Monitor, 2012).

Any new technology is risky. While there have been a number of successes and some promising starts in adoption, there have also been several attempts that have failed or been found to be impractical, at least for now. The London Underground (LU) is using NFC for their transportation service as a supplement of its existing ticketing system, Oyster. Oyster is a radio-frequency identification-based ticketing system that is fast enough to meet the needs of the LU. There are a many people using public transportation in London, and processing speed in the

payment system is vital. The LU has determined that NFC is not currently fast enough to meet these needs. However, while this has relegated NFC to a supporting role, Transport for London (TfL) intends to adapt NFC ticketing to standardize the system (Clark, M., 2012).

Parking facilities have become interested in NFC for payments, as the technology would allow them to operate without attendants, or at least not as many. San Francisco Municipal Transportation Agency has an agreement with PayByPhone to allow NFC payments at the parking structures throughout the city. Visa also an agreement for making contactless payments at 72 parking facilities in Canada (Data Monitor, 2012). However, while this would decrease employment costs and reduce waiting times, Visa will need to overcome security problems, both real and perceived. Many consumers are still hesitating to use m-payments because they feel this form of transaction is not as secure as cards or cash, that the signal could be intercepted or the phone, with its stored information, could be hacked. These are certainly a legitimate concern, one that must be addressed before NFC receives wide use. Visa is not the only organization concerned with NFC security, and some of this concern is on the national level. France has appointed Inside Secure, one of the largest NFC companies in the world, to provide security solutions. Inside Secure has recently acquired Embedded Security Systems (ESS), formerly a division of Authentec. Using ESS, which contains encryption algorithms and security blocks, the probability for protecting data and ensuring confidentiality is much higher. The French government is particularly interested in security as medical services in the nation have begun using NFC devices to transmit patient data. Patients carry a medical card with an embedded tag that the medical provider scans to access health records. While this improves the provider's knowledge and efficiency, there is concern that private information may be accessed by those with no right to it (Clark M., 2012).

These are just a few examples of the early adoption of NFC. There are a number of organizations evaluating the technology, waiting while others attempt, and sometimes fail, to adopt. This allows those that do not adopt early to learn from the mistakes of others. Therefore, even though there have been difficulties, the early adopters are attracting the attention of many other companies, causing the use of NFC to grow.

SWOT ANALYSIS

While NFC-equipped smartphones can provide many conveniences, our primary goal is to show whether they can be used to increase purchasing efficiency. We have performed a SWOT (Strengths, Weaknesses, Opportunities, and Threats) analysis in an attempt to answer this question. We have attempted to include an analysis for each from both the consumers' and the sellers' points of view. Using this analysis, we will attempt to draw conclusions about the future of the smartphone as a purchasing medium.

STRENGTHS

NFC has a number of advantages over other payment forms like cash, debit/credit cards, and checks. One of the most important of NFC technologies is their ability to run on mobile devices. The number of smartphones with implemented NFC has increased rapidly over the last year, and is expected to continue to grow (Baker, 2011). A smartphone is one of very few personal items which people are always carrying around. As smartphones have become ubiquitous, it is useful that NFC can so easily be added to them (Analysys Mason Limited, 2008). NFC technology enables users to make mobile transactions, exchange digital content easily and to connect their Smartphones just by touching them (Bodhani, 2011). With so many conveniences, consumers will rapidly become familiar with and enthusiastic about the technology. This may help people accept NFC applications for payment or for identification purpose (Ankeny, 2011). For this reasons, NFC technology has huge potential for different business and marketing models (Analysys Mason Limited, 2008).

Not only do many consumers carry their smartphones constantly, the devices are already equipped with all necessary capabilities to use NFC. They can provide battery power, often for long periods. They have significant processing power and memory for NFC applications. This technological base makes smartphones an ideal platform for NFC (Analysys Mason Limited, 2008). In addition to the omnipresence of cell phones, there is also a significant security advantage to using NFC for payments (Haselsteiner & Breitfuß, 2011). Not only do cell phone providers allow the phone to be erased remotely if lost, the phone itself can be used in what is called two-factor authentication. This is the technique of using two methods of identifying the user. One factor is what you own, and possession of the phone is that factor, similar to carrying

an ID card. Personal knowledge is another possible factor, and the phone being password protected accomplishes this. Finally, a camera-equipped smartphone can actually use facial or fingerprint recognition as another factor. In fact, all three factors could be used, making the phone a very secure way to conduct monetary transactions (Derawi, McCallum, Witte, & Bours, 2012). NFC also is compatible with other standard technologies for contactless services, such as with smartcard readers. For some enterprises that can mean a significantly reduction in costs for implementing NFC without changing or enhancing their whole infrastructure. This reduction in cost could be an incentive for more businesses to use the technology (Nambi et al., 2012).

WEAKNESSES

Of course, there will be some problems with adoption of this new technology, both from suppliers and consumers. These weaknesses are problems with the new technology itself and need to be examined when planning on NFC adoption. While smartphones are amazing devices, they do have some limitations. NFC requires some power, which is likely to reduce the life of the phone's battery. The antenna and other parts are small but they do take up some space and may require redesigning older models of phone, which can be expensive. Finally, the technology itself has to be purchased. Adding NFC to a smartphone was between three and five dollars in 2008. This cost was not expected to drop until much larger orders were placed, which is only happening recently (Romero, 2012; Analysys Mason Limited, 2008). The cost to provide the service will, perhaps, be still more significant than the cost per phone. Services requiring active nodes are the most expensive, requiring a significant installation process and electricity. Tags are less expensive to install but still require changes to the company to ensure that transactions are performed correctly within the information system. For physical products, a delivery system needs to be arranged to ensure correct and timely delivery. It may be difficult to convince the service providers that the future benefits are worth the cost (Analysys Mason Limited, 2008). Costs from manufacturers and service providers aside, there is also the issue of a small market. While the number of NFC-enabled smartphones is growing, consumers with such devices are currently a relatively small market. Without a larger number of people able to take advantage of the service, it may not be worthwhile for service providers to adopt NFC at this time. This may lead to a cycle that prevents the technology from seeing widespread use, as the reticence to adopt

the technology leads to a lack of interest from consumers in purchasing NFC-enabled phones (Analysys Mason Limited, 2008).

Finally, there are still security problems to be overcome. Cell phones have been infected with viruses and hacked, and even large organizations have had their servers attacked and broken into. All of the information stored on the phone may be insecure, and even if it is secure it may not be perceived as such. Information stored on a remote system not under the user's control, the cloud, may lead to even greater unease. Overcoming both the real and the perceived security issues will be necessary for smartphone NFC technology to progress.

OPPORTUNITIES

If the strengths of a technology outweigh the weaknesses, there must be opportunities to implement the technology. Favorable market trends for NFC include the list of other applications NFC provides, strategic alliances, the interest of many consumers in new technology, and the rise in NFC-enabled phones. With the right approach, there is a chance to profit greatly by adopting NFC technologies. Contactless payments using NFC-enabled phones can deliver an extended range of applications businesses can use to make their workflows more efficient and to make the lives of their customers easier. A company that provides these services early can lock in their customers. Few businesses currently use NFC-based purchasing systems, so the market that does can develop a loyal following, even after their competition adopts (Analysys Mason Limited, 2008). There are opportunities for co-branding or cross-marketing contracts between stores, banks, and service providers, which could help them to establish strong alliances and cooperation. For example, if the mobile provider has an exclusive agreement with a bank, which in turn has a discount agreement with a store, each of these entities drives consumers to the other two. By using such strategic partnerships, companies are able to access new customers without high costs for advertising campaigns.

Businesses can also improve their image by being first to market with NFC technologies as an innovative enterprise with high-level service for customers. That can help to make brands or stores more attractive than their competitors, especially for young and technically inclined customers, in addition to its improvements in customer interaction (Ankeny, 2011). The number

of people making mobile payments is growing rapidly, With this growing market, it is a good time to provide services that make these transactions simple, such as NFC-enabled phones and points of purchase.

THREATS

Since NFC is so new, there are also several potential problems aside from the technology itself that should be accounted for. A major potential problem with NFC is competing technology. Credit, debit, and identification cards are already a normal part of life and work well for most people. Smartcards are a directly competing technology, as they allow the same ease of use in some cases as the NFC-equipped phone. Should this technology in traditional cards see widespread acceptance, it may reduce the demand for similar, and more expensive, technology in the smartphone. Obviously, consumers are going to drive this market to a great extent. As mentioned in Weaknesses, most consumers do not have NFC-equipped phones, and even if some organizations adopt the technology, there may not be a market. Consumers must decide that the cost to purchase the phone, transfer data, and learn the new phone's controls is worthwhile (Chandra, Srivastava, & Theng, 2010). If the infrastructure is not created because there are too few customers, customers will not purchase the device due to a lack of infrastructure. This could perpetually prevent adoption of the technology.

Consumers may also be leery of the security of the new technology: the more computerized the system, the more vulnerable it may be to malware and other attacks. These factors, in addition to the ordinary reluctance to change, may keep consumers from adopting the technology, making it useless to the service providers (Chandra, Srivastava, & Theng, 2010). Even if the technology is ultimately accepted, there is always the possibility of changing laws increasing its cost or otherwise making it more difficult to use. Since information about banking and finance would be exchanged through NFC, there will be legal requirements for its security and recordkeeping. This may ultimately make the technology too expensive for many organizations that would otherwise provide it (Analysys Mason Limited, 2008).

DISCUSSION

In discussing our research, we need to examine both positive and negative elements of this new technology and compare them to each other. We will also examine a few other items that do not directly beneficial or detrimental to the adoption of NFC, but provide some insight into its future. After that, we draw our conclusions about the future of NFC-enabled smartphones and the payment options that they provide.

ADVANTAGES

To be competitive, enterprises should always try to reduce costs and increase revenues. One way to reduce costs would be to improve the efficiency of work-flows. Increasing revenues generally involves attracting new customers or inciting current customers to buy more. It is also important to retain current customers. Proximity m-payments using NFC can be of use in all of these areas. On the subject of reducing costs, NFC-based payments are quick and convenient once the infrastructure is in place. Perhaps the customer waves the phone at a picture of a desired item and the purchase is automatically made. Vending machines can be designed to allow NFC use, which provides the product immediately. Even at a regular point of sale the contactless payment system allows the customer to purchase items without having to pull out one or more cards, simply present the smartphone to the cashier briefly, and identification and transaction are completed. This enhanced efficiency in sales will certainly reduce costs in that area of business.

For attracting new customers, NFC devices are a new technology, and there are always people that want to try new things. If the technology works well for them they will talk about it to others. Any company that adopts the technology now will be the beneficiaries of this word-of-mouth advertising. Therefore, this is a great opportunity to get new customers. Another way to attract new customers with NFC-enabled contactless payments is through strategic partnerships. The technology will work best when financial institutions, stores, and phone providers work together to the extent they can. For instance, Vodafone and Visa are planning to work together to bring contactless payments to 80% of Vodafone's customers, a rather ambitious goal that the phone company probably should not attempt alone. This kind of partnership can cause Vodafone customers to favor Visa, and Visa customers to switch to Vodafone, benefiting both companies. Contactless payments can also allow greater sales to existing customers. Because contactless

payments are quick and devices to allow them can be placed in non-traditional locations, such as the Korean subway, it gives opportunities for customers to buy more products. The previously mentioned vending machines can benefit by not requiring customers to have small bills or change, the lack of which would otherwise prevent sales. This convenience allows for greater spontaneous purchasing, and thus increases sales.

Finally, for customer retention, since NFC devices have so many other uses, such as the museum tour and the exchanging of music playlists, consumers can be expected to be familiar with and enthusiastic about the technology in a short time. As a result, it can be expected that consumers will want to use the technology in new ways. Companies adopting ahead of this trend are likely to keep their customers more satisfied than companies that do not, and so not only retain customers but attract some from non-adopters.

DISADVANTAGES

NFC in smartphones is still a very new technology. As a result, the full implications have not been worked out and mistakes will be made. For example, the London Underground attempted to adopt. After investing in the technology and installing it at various sites they found problems with the response time of NFC and were forced to make it a secondary system to the Oyster technology already in place. This reduced greatly the return on that investment. Careful examination and planning are essential, but with something this new not always effective, and there is always a risk that the new system will fail when going live.

As mentioned, a weakness of NFC technology is the potential for security problems. Some of this is legitimate, but even a perception of the technology as insecure can hurt implementation plans. Payments using the cell phone system are broadcast, so that form of transaction is worrying to consumers as the signal might be intercepted. While proximity payments can be more secure, if they are perceived as the same as the broadcast m-payment consumers may not use it. Still, it is worth noting that other payment methods often have similar security issues. Whether transaction information is accessed by a card or by a phone, it is still vulnerable to attack where it is stored or over the transmission system that communicates with the bank. If the transmission system is built into the store, whether you use the phone or the card, the risks are

the same: the transaction is being sent over the exact same medium. If consumers can be convinced that the phone is as secure as the card, at least for proximity m-payments, they may be convinced to change.

OTHER CONSIDERATIONS

No matter how beneficial NFC-enabled payments may be, a company that does choose to adopt NFC should first make consumers aware of the technology and how it benefits the buyer. If they make this change without creating excitement for it, it will not do as well and may actually backfire, losing the company revenue. For example, consumers may find contactless payments to be a waste if they are not made aware of the benefits first, and a wasteful company is often perceived as an expensive one. The benefits of an NFC implementation are useless without customer knowledge of it. The adopter should also make sure to understand the habits, technological ambitions, and security preferences of their customers. If these things are taken into account, they have a good chance of success.

On a final note, we noted that Nintendo has installed NFC technology into its new game console, the Wii U. By providing the possibility of NFC-enabled games and store transactions within the console, Nintendo has taken a huge step toward making its customers familiar with the technology. NFC has become part of entertainment, and that association will linger in consumers' minds. Having the technology in the console also brings NFC to a new market, as before it was primarily a point-of-sale technology and now can be seen in e-commerce and the gaming industry. This demonstrates that the technology has the potential to bring benefits to many different businesses. As a result, it may spread still faster than predicted.

CONCLUSIONS

In this paper we examined ways for NFC to help businesses and satisfy customers. It can be used to enhance efficiency by providing new and convenient ways to conduct financial transactions and identification of the user. NFC can make financial transactions faster, more convenient, and more accessible. This can reduce long lines and make the customer experience better overall. NFC does have its share of problems, as is expected with any new technology. It is not widespread, so service providers, such as stores and banks, are unlikely to implement the

technology until more customers can take advantage of it. Customers have to be convinced that these transactions are trustworthy, as the security of the devices may still be in question. Customers must also be convinced to change from an established technology to a new technology, which is always a difficult task. Still, there are companies that have already implemented NFC successfully. This has been most pronounced in countries like South Korea or Japan, where they had already used similar technology and were therefore more prone to adopt. While the technology has not been as successful so far in Europe, Australia, or the United States, these successes demonstrate the advantages of using NFC.

Based on our research, we believe that companies can improve their efficiency and customer confidence by using NFC technology. They should, however, take into account several things before jumping into this field. As always, they should make sure that they are focused on helping customers to accept the new technology, and ideally the customers should be excited about it before implementation. Even if they have to invest heavily in marketing campaigns before launching, this is necessary to ensure that the investment in the technology itself is worthwhile. Once accepted, NFC can be used in many areas from transportation to shopping to health care services. If companies take these elements into account and see the potential of NFC to improve their efficiency draw in customers, we believe that they will benefit. We see many possibilities for the future of NFC-enabled smartphones, especially in identification and purchasing. As such, we conclude that the use of NFC will increase steadily over the next few years and businesses should take advantage of this growing market early to gain the maximum benefit.

References

Analysys Mason Limited. (2008). *Mobile proximity payments: scenarios for market devopment.* Retrieved from Analysys Mason: http://www.analysysmason.com/PageFiles/4588/Mobile_proximity_payments_sample_pages.pdf

Ankeny, J. (2011, February 22). *The new smart money*. Retrieved from Entrepreneur: http://www.entrepreneur.com/article/218100

Baker, J. (2011, April 18). *Strong growth expected for NFC-enabled smartphones, pyramid finds*. Retrieved from PR Newswire: http://www.prnewswire.com/news-releases/strong-growth-expected-for-nfc-enabled-smartphones-pyramid-finds-120111709.html

Bodhani, A. (2011, November). Smartphones pay the price. *Engineering & Technology*, pp. 56-59.

Chandra, S., Srivastava, S. C., & Theng, Y.-L. (2010). Evaluating the Role of Trust in Consumer Adoption of Mobile Payment. *Communications of the Association For Information Systems*, 561-588.

Clark, M. (2012, November 12). *French carers to use NFC*. Retrieved from NFC World: http://www.nfcworld.com/2012/11/12/321066/french-carers-to-use-nfc/

Clark, M. (2012, November 15). *Korean museum offers NFC visitors guide*. Retrieved from NFC World: http://www.nfcworld.com/2012/11/15/321152/korean-museum-offers-nfc-visitors-guide/

Clark, M. (2012, November 20). *Vodafone Australia sets out NFC payment plans.* Retrieved from NFC World: http://www.nfcworld.com/2012/11/20/321229/vodafone-australia-sets-out-nfc-payment-plans/

Clark, M. (2012, May 23). *Transport for London delays arrival of new ticketing technology.* Retrieved from NFC World: http://www.nfcworld.com/2012/05/23/315867/transport-london-delays-arrival-new-ticketing-technology/

Clark, S. (2012, February 24). *FeliCa Networks signs deal with Samsung for Japan's move to NFC*. Retrieved from NFC World: http://www.nfcworld.com/2012/02/24/313708/felica-networks-signs-deal-with-samsung-for-japans-move-to-nfc/

Clark, S. (2012, November 19). *Pepsi Special gets Tokyo NFC advertising campaign*. Retrieved from NFC World: http://www.nfcworld.com/2012/11/19/321213/pepsi-special-gets-tokyo-nfc-advertising-campaign/

Data Monitor. (2012, January). New York and New Jersey transit system tap into NFC ticketing. Data Monitor, pp. 5-6.

Data Monitor. (2012, March). Contactless and NFC payments develop into a niche transport market in Canada. Data Monitor, pp. 24-25.

Data Monitor. (2012, March). Nintendo's WiiU will drive NFC uptake. Data Monitor, p. 21.

Data Monitor. (2012, April). NFC comes to Japan with strings attached. Data Monitor, p. 22.

Derawi, M. O., McCallum, S., Witte, H., & Bours, P. (2012). Biometric access control using near field communication and smart phones. Biometrics (International Conference on Biometrics), 2012 5th International Association of Pattern Recognition International Conference on (pp. 490-497). New Delhi: Institute of Electrical and Electronics Engineers.

Douglas, M. (2012, February). Reach out and touch someone. Urgent Communications, pp. 14-18.

Gurley, S. (2012, April 29). NFC Will Change Things – Perhaps In A Big Way. Retrieved from Steve Gurley's Blog: http://stevegurley.wordpress.com/category/digital-signage/

Haselsteiner, E., & Breitfuß, K. (n.d.). (2011) Security in near field communication (NFC). Institute for Applied Information Processing and Communication. Austria.

Irene. (2012, September 20). What Is NFC and What Can It Do for You. Retrieved from Technology News & Tips Hub: http://video-sharing-hub.blogspot.com/2012/09/what-is-nfc-and-what-can-it-do-for-you.html

Kramer, S. (2012, June 19). Gartner projects mobile payments to hit 171.5 billion. Retrieved from V3 Integrated Marketing: http://www.v3im.com/2012/06/gartner-projects-mobile-payments-to-hit-171-5-billion/#axzz2DXvzSrFK

Morak, J., Hayn, D., Kastner, P., Drobics, M., & Schreier, G. (2009). Near field communication technology as the key for data acquisition in clinical research. 2009 First International Workshop on Near Field Communication, 15-19.

Nambi, A. U., Prabhakar, T., Jamadagni, H., Ganapathi, K., Pramod, B., Rakesh, C., & Sanjay, N. R. (2012). Near field communication – applications. Berlin Heidelberg: Springer-Verlag.

Pope, M., Pantages, R., Enachescu, N., Dinshaw, R., Joshlin, C., Stone, R., Seal, K. (2011). Mobile payments: the reality on the ground in selected asian countries and the united states. International Journal of Mobile Marketing, 88-95.

Romero, J. J. (2012, June). No more waiting on near field communication. IEEE Spectrum, p. 64.

Serfass, D., & Yoshigoe, K. (2012). Wireless sensor networks using android virtual devices and near field communication peer-to-peer emulation. Little Rock: Institute of Electrical and Electronic Engineers.

Strommer, E., Hillukkala, M., & Ylisaukko-oja, A. (2007). Ultra-low power sensors with near field communication for mobile applications. International Federation for Information Processing, 131-142.